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Synopsis of Information Requirements in Future Medical Operations

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Synopsis of *Information Requirements in Future Medical Operations*

by Neil B. Carey, Cori R. Rattelman, and Hung Q. Nguyen

This CNA annotated briefing (CAB) summarizes the findings of the Information Requirements in Future Medical Operations project, sponsored by the Deputy for Marine Corps Medical Matters (N-093M).

This CAB is a synopsis of the project and focuses on the implications of our research rather than the methodological details of how we reached our conclusions. For a detailed account of our methodology and findings, please refer to CNA Research Memorandum (CRM) 96-70, *Information Requirements in Future Medical Operations*, by Neil B. Carey, Cori R. Rattelman, and Hung Q. Nguyen [1].

Future Challenges

- Today: overreliance on scarce communications
  - Security concerns
  - Inefficient
- Future battlefield will complicate medical's tasks
- Lack of understanding of future technology
  - Unrealistic expectations

Our observations going into the Information Requirements project were influenced by our experience during exercise Kernel Blitz last summer. In that exercise, we saw some disastrous lapses in situational awareness that would have caused casualty deaths and air safety hazards. In addition, a lack of communication discipline wasted valuable voice communications, and caused coordinates to be repeated over the open airwaves.

The future battlefield will see changes that will make matters worse:

- Casualties may occur as far as 200 n.mi. away from surgical care.
- Forces will move more independently, making it harder to locate casualties.
- Casualties will be more highly interspersed with enemy forces,increasing the dangers of evacuation.

Many people believe that the tremendous increases projected for the capacity of tomorrow's communications will solve today's problems and those that will be caused by the future operational concepts. In fact, though, <u>there will still be limits in the future,</u> making it imperative that medical specify its information requirements, be well trained, and maintain communication discipline. If medical does these things, it can use tomorrow's improvements to increase medical capability to meet new challenges.

The main purpose of this project is to help Navy medicine anticipate and make better use of the new technologies that will soon be here.

Objective

Identify future information requirements for medicine:

- *Focus on front-line care and green meeting blue*

The objective of this study was to identify information requirements for medicine, focusing on the front line—from the point of injury to definitive care. This includes the hospital corpsman, who provides emergency first aid, through the surgical company, which performs resuscitative surgery to allow the casualty to be evacuated further; we go up to but not beyond primary casualty receiving and treatment ships (PCRTSs).

This study stops when the casualty goes to the next higher level of care (i.e., we did not look at fleet hospitals, hospital ships, or CONUS care). The needs for information at those higher echelons might be different from what we determined in our study.

Several studies, such as the Theater Medical Information System (TMIS), Theater Medical Information Program (TMIP), and Naval Health Research Center (NHRC), have focused on shipboard, peacetime uses of telemedicine technologies. We do not deal with these technologies in our study.

We used needline analysis—the same as was used in a GTE bandwidth requirement study [2]—and we used similar scenarios in estimating communication requirements. GTE started at the PCRTS and went back (toward CONUS); we started at the point of injury and ended at the PCRTS. Therefore, our study nicely complements the GTE study.

Summary Findings: Information Requirements

- **Training** is most important information requirement for initial treatment.
- **Low-end** technologies are sufficient to support most medical functions.
  - Surgical company is first place for image or video.
- **Integrating** with warfighters' systems, medical would need:
  - Evacuation, regulating, and tracking system
  - Medical supply system
  - Treatment system.

In determining information requirements, our first major finding was about training. Especially at the site of injury and for immediate and emergency treatment, training was by far the most critical form of information required. It weighs nothing, takes up no space, and can be applied immediately.

Besides training, we found that low-end technologies, such as voice communications and data transfer, are sufficient to support most of what medical does near the point of initial injury in time of war. This conclusion is driven by the types of patient conditions that require treatment in the field as well as the limitations of time, equipment, and supplies. These constraints severely limit the ability to use information that is pushed to the treater. We also found that, while video and still image were overkill in supporting many of the very basic kinds of procedures required at those initial points, video and image might be beneficial at fixed surgical facilities. The surgical company relies less on mobility and, therefore, can support more equipment; in addition, the ability to consult with specialists using video teleconferencing or exchange of still image (e.g., teleradiology) could substitute for the lack of specialists at the newly reconfigured surgical company.

By integrating with tactical and operational systems of the warfighter, medical could obtain needed information with just three systems: one for evacuation, regulating, and tracking; another for medical supply; and a third for treatment. *Although these systems would not necessarily be distinct from each other or from other operational systems, we discuss them as distinct entities throughout this CAB for the sake of clarity.*

The rest of this briefing expands on these major conclusions.

Two Questions

- What are Navy medicine's minimum information requirements for fulfilling its roles in the future?

- What information and communication technologies can deal with the future environment?

Our analysis answers two questions:

(1) Given the future battlefield, what is the minimum information that medicine needs to function in this environment?

and

(2) What is the capability and feasibility of current and future technologies for supporting these requirements?

How Do We Answer These Questions?

Four-Step Method:

- Determine future characteristics of battlefields
- Develop medical model of operations
- Identify requirement drivers and requirements
- Evaluate feasibility (specs, impact)

Answering these questions poses a challenge. How do you develop requirements when the future world and technology are unknown? We developed a four-step method for doing this.

First, we described in detail the future environment in which medical will have to operate.

Second, we determined how medical will be structured to deal with that new environment and developed a medical model of operations. By "medical model" we mean a listing of the communication nodes through which information must pass for different purposes: i.e., who will be talking to whom.

Third, we developed "requirement drivers" that specify where and when information can be most useful to medical. From those drivers, we specified medical's information requirements.

Finally, we looked at the feasibility of different technologies for meeting those information requirements, specifying the technical characteristics of needed systems and evaluating their costs (in terms of bandwidth) and potential for future use.

Step 1: Future Battlefield

- Major departure from the past
  - More dispersed, independent units, flatter command structure
  - Greater uncertainty
  - No front or rear lines
  - Sea-based Combat Service Support (CSS)
  - Enhanced tactical and operational information and communication architectures

We've worked closely with the Commandant's Warfighting Lab to determine what will be the new challenges for medical. We've translated the generic description of the battlefield into what it means specifically for medical.

We found that:

- Even though fewer Marines ashore may imply fewer casualties, casualties may occur as far as 200 n.mi. from surgical care.
- Forces will move more independently, making it harder to locate casualties.
- Casualties will be more highly interspersed with enemy forces, increasing the danger to both the casualties and those who evacuate them.
- More CSS, including medical, will be sea-based, and in some cases all CSS will be sea-based, placing great stress on the available transportation assets.
- Units will be smaller and may need to function even without organic medical support, i.e., no unit corpsman.

These operational concepts will require very different and more capable communications and information infrastructures to support the warfighter. Although these enhanced capabilities will provide some opportunity for medicine, additional requirements from the warfighters will still be the priority.

These circumstance are so different from today's battlefield that Navy medical needs a completely new way to provide support. In our second step, we develop a basic framework for how medical <u>might</u> function in the future.

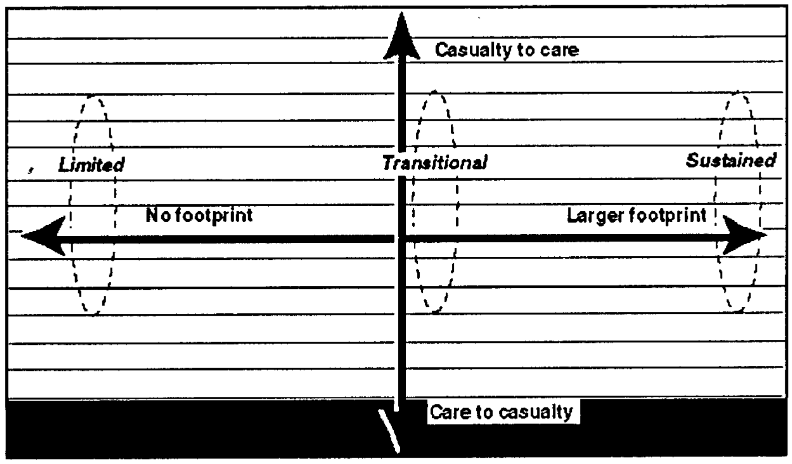
Step 2: Develop Medical Models of Operations

- Identify operational space—range of situations and strategies
- Select a subset of options that encompasses as much of that space as possible

Based on (1) our discussions with the Commandant's Warfighting Lab, (2) interviews and focus groups with corpsmen and members of the Medical Corps and Medical Services Corps at I and II MEF, and (3) a review of Army, Air Force, and Navy publications:

- We defined an operational space in which medical will function in the future. This space reflects a range of operational situations and medical strategies for supporting combat.
- We selected a set of possible operational scenarios and medical configurations that represents as much of this operational space as possible.

Range of Situations and Strategies

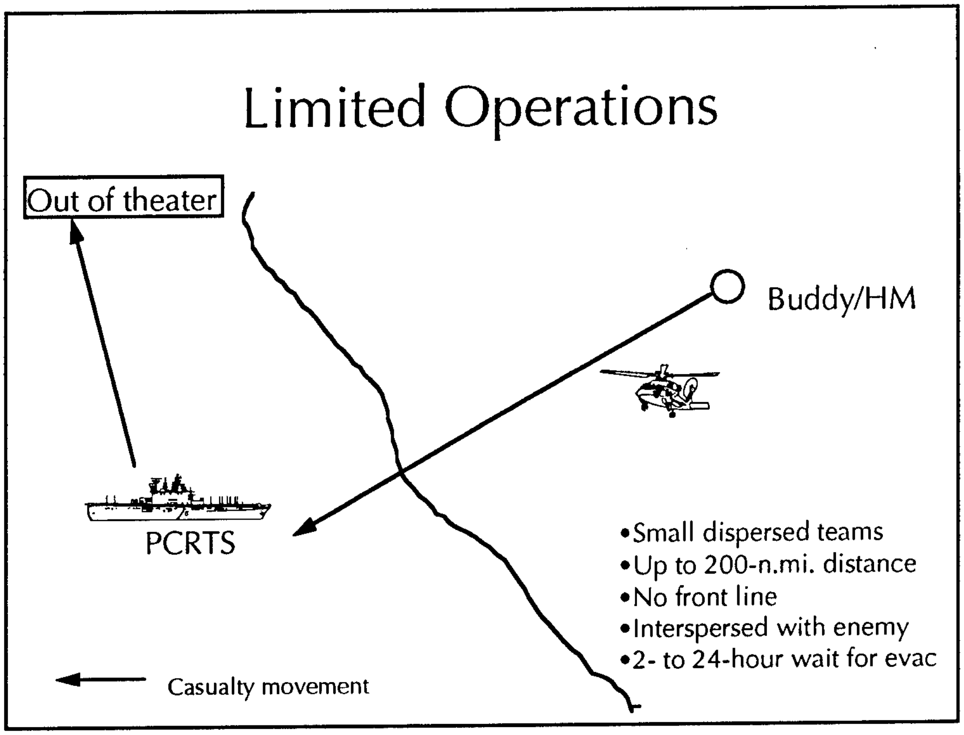


This graph reflects the space in which medical will operate in the future. We represent this as a two-dimensional space defined by the two dominant characteristics that determine how medical will operate in any given situation in the future. These characteristics are:

- *The operational situation*, defined by the warfighter and reflected in this graph by the size of the footprint operationally permitted ashore. This can range from zero footprint ashore, such as in some of the more extreme Sea Dragon concepts, to a substantial footprint ashore, such as the traditional amphibious operations that are supported by the BAS, medical battalion, and field hospitals in theater.

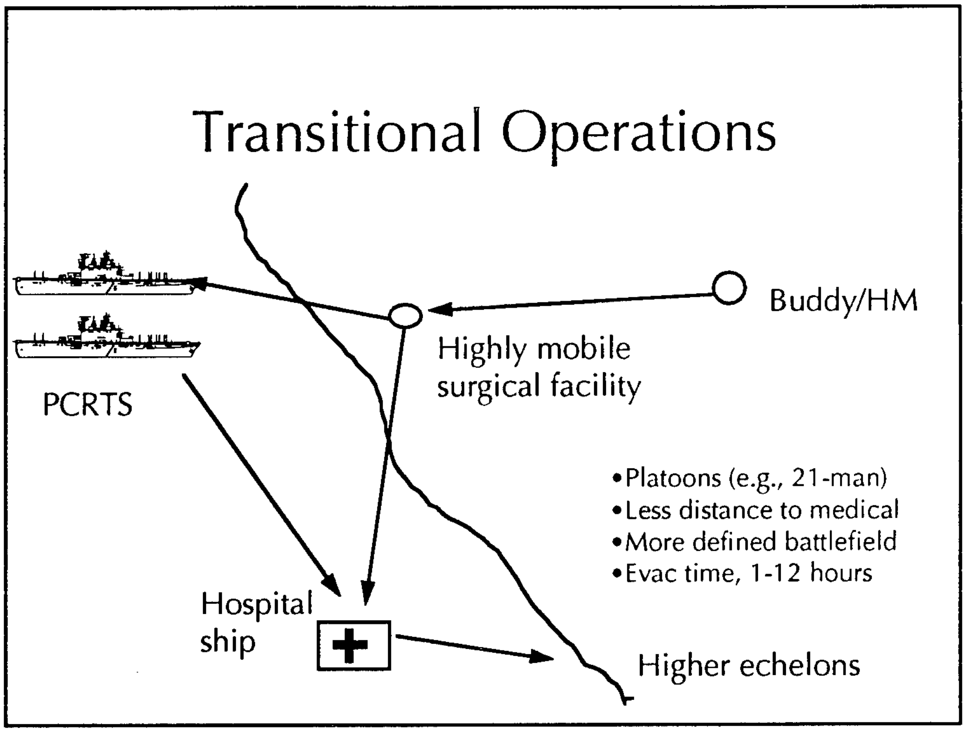
- *The medical strategy*, from bringing the care to the casualty to bringing the casualty to the care. See [1] for more detail.

For each operational situation along the horizontal axis, medical will have a continuous set of configurations that it is capable of providing. We represent this range of options by the dashed oval intersecting the x-axis along a given segment. A particular configuration along this oval line may dominate the others, depending on the availability of transportation resources, the status of operations (e.g., can helos fly in and out at will for medical evacuation?), and medical's preferred strategy for support.

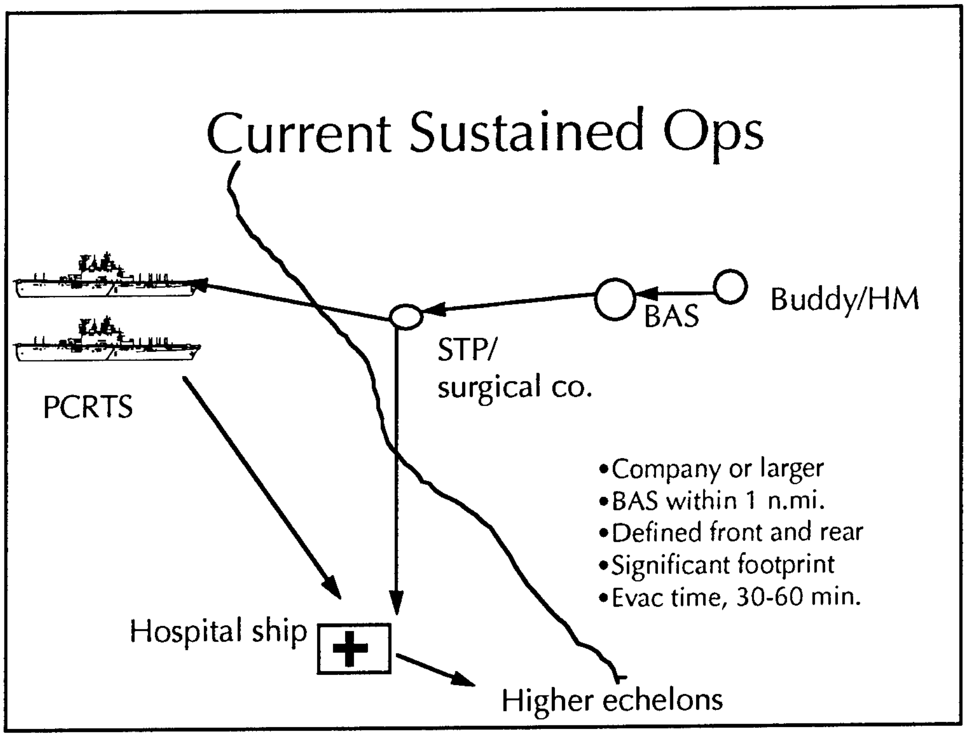


In examining information requirements, we concentrated on three options: limited, transitional, and sustained operations. These three configurations cover the expected range of future operations. The next three slides quickly review the characteristics of those configurations.

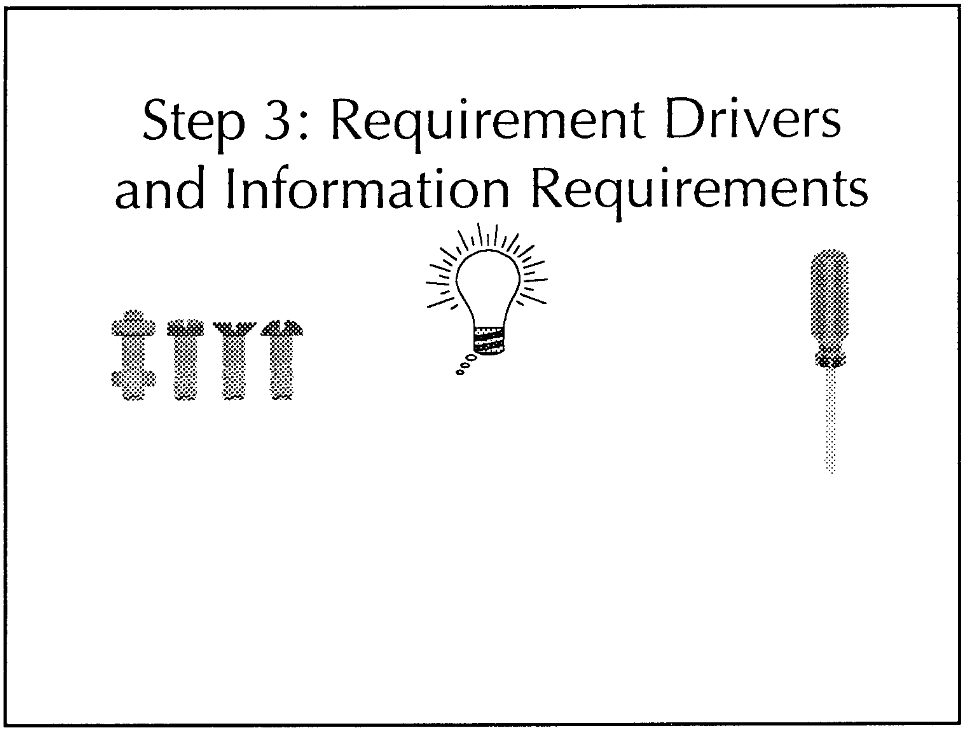
We begin with this limited operation. The constraint in this scenario is that there will be no support footprint ashore. Small, highly dispersed teams will be operating as far as 200 n.mi. from their ship. Because the teams are functioning in unsecured territory, interspersed with enemy, it may be impossible to fly helicopters in for medical evacuation until the cover of darkness. Because of the distance inland, ground and surface medevac will be impossible. We assume that a notional MEU would be a probable force configuration, with about 130 four-man teams. Some teams will have corpsmen, who function as a team members with primary medical responsibility.



In the transitional scenario, a limited support footprint is permitted ashore. The basic operational infantry unit in this scenario is a 21-Marine platoon. While the battlefield is more defined under this scenario (there are pockets of secure territory), there will still be dispersion among the platoons, vast distances to be covered, and no clearly defined front line or rear. We assume that a notional MEF (FWD) would be a likely force size in the transitional scenario. In addition to corpsmen, some ground medical support will be provided by a Highly Mobile Surgical Unit (HMSU). The unit will probably be very light but still have some ability to sustain itself.



Finally, the sustained scenario will allow for a significant support footprint ashore. This will include the unit corpsmen, battalion aid station (BAS), shock trauma platoons (STPs), surgical companies, hospital ships, and fleet hospitals. There will be a secure rear area, allowing for easier and more timely medevac, although availability of evacuation assets may still be operationally limited.



"Requirement drivers" determine your information requirements: who needs to communicate with whom, and what information needs to be passed.

Using our three selected operational configurations as templates for the future battlefield, we determined the drivers of information and communication requirements. The following slides briefly review what those drivers are, and how they determine requirements.

Requirement Drivers

- Functions
  - Decisions
- Resources
  - Time, personnel, equipment
- Patient conditions: "clinical opportunities"
  - Prevention, treatment, consultations

Based on our analyses, functions, resources, and conditions are the three primary drivers of information requirements.

The first determinants of information requirements are the functions that Navy medicine assumes. We identified seven such functions:

- Preventing casualties
- Locating casualties
- Clearing and protecting
- Assessing, diagnosing, and triaging
- Treating and sustaining
- Evacuating, regulating, and tracking
- Providing medical supply.

Requirement Drivers (continued)

- Functions
  - Decisions
- Resources
  - Time, personnel, equipment
- Patient conditions: "clinical opportunities"
  - Prevention, treatment, consultations

Resources are a second major driver: How much time does the treater have, what personnel are available for treatment, and what equipment will the treater have available? Based on Vietnam data, 40 percent of deaths are immediate, and another 25 percent die within 5 minutes of injury. Another 15 percent die before 30 minutes have passed. These time limits make the casualty, the corpsman, and the BAS staff the most probable personnel to make life-saving interventions. These people have access to very limited equipment and supplies. It is of no use to get information to perform procedures for which you haven't the proper equipment.

Third, patient conditions, or "clinical opportunities," also determine information requirements. Treatment of a casualty suffering from a penetrating missile to the head requires very different information than does treatment of a casualty suffering from blood loss to an extremity.

Information Requirements

Three systems:
1. Evacuation, regulating, and tracking
2. Supply
3. Treatment

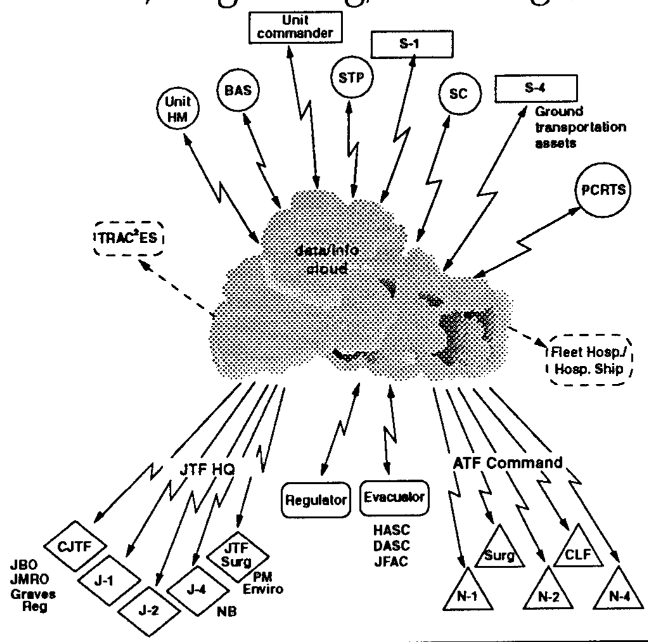
Based on our analysis of the requirement drivers, we found that three systems would be sufficient for medical's information needs: one for evacuation, one for supply, and a third for treatment. For each of these systems, we developed extensive matrices that specified the minimum information items needed, and we identified who needed to extract or contribute information.

We outline, in general terms, what communication systems are needed to carry the required information. In describing the communication systems, we give examples of the kind of information these systems need to carry.

1. Evacuation, Regulating, Tracking

In Kernel Blitz, we observed the most difficulties in evacuation, regulating, and tracking. Players didn't know where casualties were or whether casualties had been evacuated. Independently produced pieces of paper accumulated on each casualty as he was moved from one point of the system to the other. The papers reidentified casualties, often inconsistently, and also attempted to keep track of what medical procedures had been performed.

1. Evacuation, Regulating, Tracking (continued)



We identified the MAJOR PLAYERS who need to play in evacuation, regulating, and tracking to ensure an efficient and effective system. Conceptually, it is not difficult: The primary system's MAJOR PLAYERS are the field units/MTFs on the ground, the ATF, and the JTF commands.

When we include all nodes within the MAJOR PLAYERS, however, it is clear that the abundance of players makes voice (the current system) impractical: we need a data system.

Voice is demanding and cumbersome to support all of these players, slow, and subject to human error and misinterpretation. This suggests that an evacuation system needs a simple, straightforward information system based on DATA, not voice.

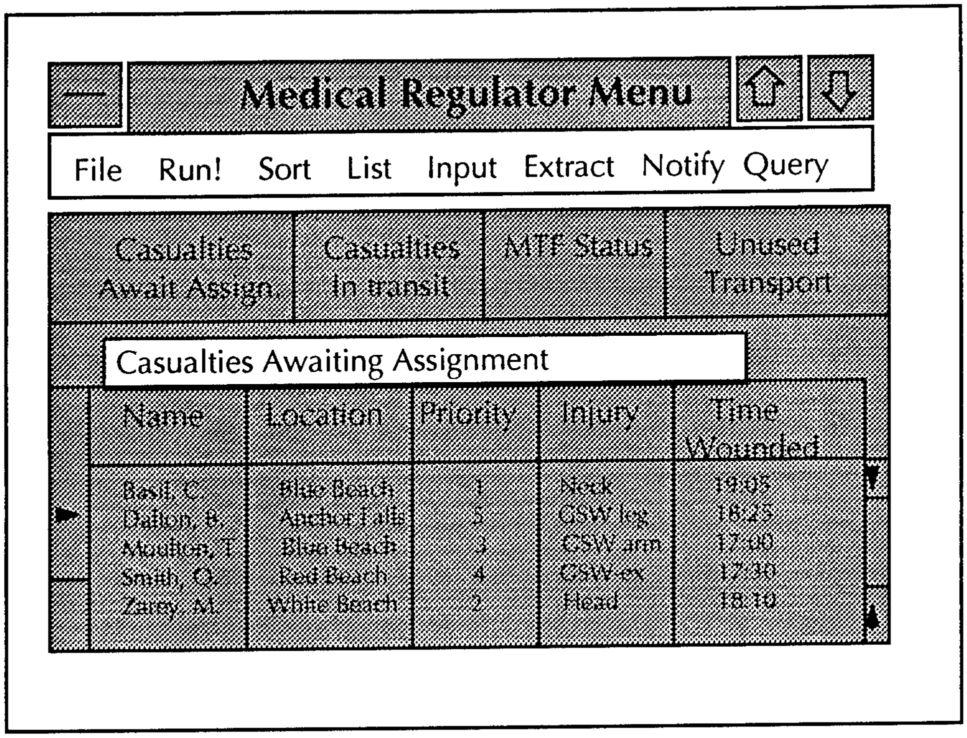
We depict this evacuation and tracking system as an "information cloud." This system could be accessed on a need-to-know basis, with different players using different templates to screen out irrelevant information and to highlight essential information.

1. Evacuation, Regulating, Tracking System

- Low-rate data with voice backup
- Smart push, user pull
- Electronic bulletin board, real time
- Data elements
  - Casualty identifiers
  - How soon, where casualty needs evac
  - Operating status of medical facilities

All participatents will input relevant information into the "data cloud" and/or selectively take information out. For example, the unit commander would both input and extract information. In contrast, ATF and JTF HQs would primarily extract information. Information can be "smart pushed" or "pulled." "Smart pushed" means that critical information is automatically updated without intervention by users; "pulled" means that users actively request additional data.

This system would allow such products as an electronic bulletin board that would provide a nearly real-time picture of the evacuation, regulating, and tracking process. The report of a casualty needing movement would automatically go into a database by using a smart card and personal digital assistant (PDA).



As an example of the type of data system we envision, the regulator's status board would have a series of computer menu screens, such as "Casualties Awaiting Assignment," "Casualties in Transit," "MTF's Status" and "Status and Location of Unused Transportation Assets." The regulator could view any particular screen by clicking a mouse.

Note that this evacuation and tracking system is quite an advance over the old, dedicated regulating net used in traditional amphibious operations. In the proposed system, voice would be a backup only; in the old system, voice is the primary mode of communication, at times, inefficiently mimicking a data system with hourly updates carried over voice lines in prescribed patterns.

With the new data system, information could be archived, so that "old" information would not be lost, and all players requiring a subset of information would have access to the same information source. This change is a real improvement over the old handwritten "grease pencil" status board currently in use.

For this system, main data elements would include such things as casualty identifiers, how soon the casualty requires evacuation, where the casualty is going, and operating status of medical facilities.

2. Medical Supply System

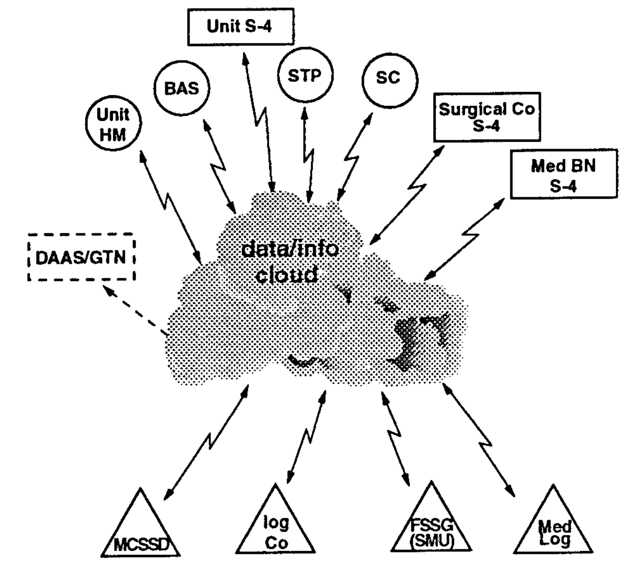
The supply system has also been a source of trouble for medical. In Desert Shield/Desert Storm, problems keeping track of supplies were widespread. Often the AMALS contained supplies that had expired; others were mismarked. In one instance, personnel had to open 30 containers to find supplies that should have been in 2 containers.

Medical carries 30 days of supplies because it doesn't think it can depend on the supply system.

The future concept of operations would only make these matters worse. Medical can't carry 30 days of supplies and keep up with the faster, more mobile operations. And they won't have time for the kind of confusion about contents of containers in future Therefore, we need a data system that can accurately track supply use; the system should also be able to anticipate future needs.

An information system can alleviate many of the problems with today's system. If players know how many supplies they have, and can depend on getting supplies when they need them, they will not have to carry so much.

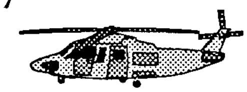
2. Medical Supply System (continued)



This figure shows that all treaters and treatment facilities, starting with the HM, will be able to input orders and access information from the system. An electronic bulletin board can be created and maintained by the FSSG using information from the data cloud. The bulletin board would allow all interested and participating parties to have continuous access to the status of medical supply orders in the system. Voice communications would be a backup in case the bulletin board goes down and to make sure that errors are corrected.

A supply system must be data (not voice) to ensure AWARENESS—constant awareness of location, contents, and expiration status of supplies in the system, combined with automatic updates as status changes. One should be able to scan a bar code and have the contents recorded and sent to others.

2. Medical Supply System



- In-transit visibility
- Low-rate data, voice backup
- Data elements
  - Name and location of unit ordering supply
  - Priority of the supply order
  - Approximate delivery date wanted
  - Confirmation order was received

A major goal of future supply systems is to have in-transit visibility, so that it would be easy to determine the status of a request in the supply route. As with the casualty evacuation, regulating, and tracking system that we described earlier, the medical supply system would rely on low-rate data with voice used solely as a backup.

For example, the number on each AMAL would be keyed to codes that match with a supply database indicating when the order was filled, the expiration dates of supplies within the AMAL, and the unit responsible for the packing and upkeep of the AMAL. The people looking at the outside of the AMAL could tell all these facts without opening it. From a different perspective, the medical unit "consumer's templates" would have access to a database that would tell what supplies have been ordered (or have been ordered automatically), the amount of those supplies, and so on.

For the supply system, main data elements would include, for example, name and location of the unit ordering the supply, priority of the order, approximate delivery date desired, confirmation of receipt, approximate delivery date/time to the logistics officer, and approximate date/time of delivery to the medical treatment facility (MTF).

3. Treatment and Sustainment System

Today's ability to get information to the treatment and sustainment system has weaknesses. Because the corpsman must write basic information on the field medical card, his hands are not free to do other things. Dog tags are supposed to have the infantryman's blood type, but we are told that the blood type information is often wrong. Quick evacuation of casualties from the battlefield could compensate for these weaknesses. For example, quick evacuation to a rearward facility makes the blood type information on the dog tag less important. Similarly, the field medical card is designed to carry very limited information.

In short, the treatment and sustainment system today relies heavily on the quick evacuation of casualties to the next echelon of care. As stated earlier, however, casualties might not receive fast evacuation in future battlefields.

3. Treatment and Sustainment System

A. Training is primary information source

B. Individual patient information

- Low-rate data
- Medical records, prevention database

C. Consultation capability

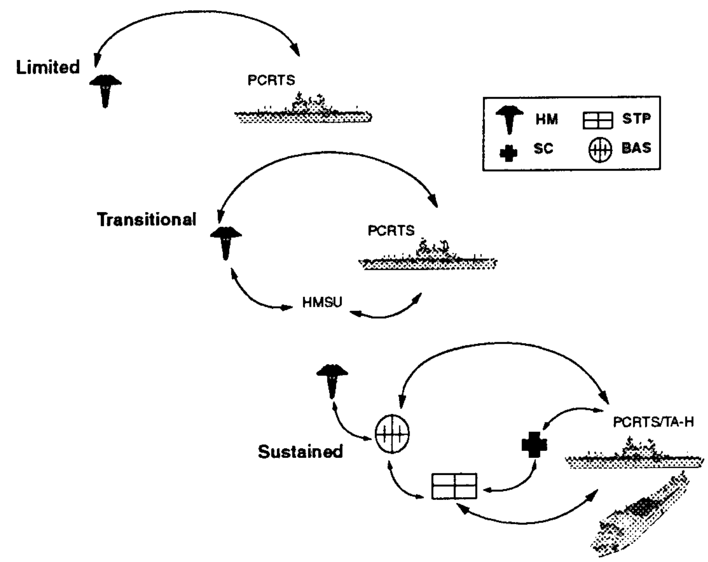
- Voice is primary source for consultation
- E-mail and limited image and VTC capability

One of the major conclusions we drew from our analysis is that trained personnel are the most important information source for the treatment of casualties in the field. Training has always been critical, but on the future battlefield corpsmen and even Marines will be expected to function in a medical capacity without the benefit of a battalion surgeon a mile away, and they may be required to sustain casualties for long periods of time, as much as 24 hours.

To support treatment of casualties in the field, we identified additional information requirements that include a data system to access and transfer individual patient information—medical history, drug allergies, initial casualty assessment, and treatment. This system could also be used to develop a preventive medicine database to track, monitor, and prevent disease outbreaks.

Finally, we found the need for a consultation system to support treatment of casualties under the new concept of operations. The lack of support available to all levels of casualty treatment (Marine, field corpsmen, BAS, STP, and surgical company) as a result of sea basing CSS, dispersion of troops, and longer evacuation waits requires that personnel treating casualties have access to experienced physicians and specialists for consultation and monitoring. This access would be provided primarily through a voice system, but could also be provided through E-mail and on a limited basis via image transfer and VTC (available at the surgical companies only).

Treatment, Consultation System



This figure shows a consultation system for our three sample configurations. In the limited, or "Sea Dragon," configuration, 80 or more corpsmen might be working independently in small, widely dispersed teams. The likelihood for need of consultations is particularly high for that scenario. In the "transitional configuration," we add the HMSU, which shares many of the problems of dispersion and danger that independent teams might face in the limited scenario.

In the sustained configuration, we added the battalion aid station, the shock trauma platoon, and the surgical company. At each site of care, communication capability will be given to the most highly trained medical caregivers. Caregivers will consult primarily with physicians and specialists who are closest to their site of care. For example, corpsmen consult mainly with physicians at the battalion aid station. The capability to transmit still imagery or video teleconferencing may be available at the surgical company, but not before.

As we've said before, training is essential to an effective consultation system. We heard many times that it is impossible to talk someone through a procedure he hasn't done or seen before.

The major point of this slide is that adding voice communications, while advisable, results in a tremendous number of possible connections between infantrymen, corpsmen, and consulting physicians. We have added an important capability, but at a price that must be calculated. The next section of the study makes those calculations.

Operational Considerations

- Durability, reliability, security, ease of use, interoperability
- Advanced Warfighting Experiment:
  - Oversensitivity of equipment
  - Slowing of medics' response times
  - Difficulty with communications discipline
  - Concerns about security
- Backup systems

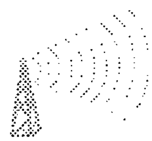
Finally, for all of the systems we have just described, it is critical that equipment be able to withstand extremes of hot, cold, and wetness, that it be reliable, have a low probability of detection, be easy to use, and be compatible with other services' systems.

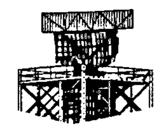
Although these characteristics seem like common sense, they are sometimes difficult to attain. Early reports of the results of the Army's Advanced Warfighting Experiment's use of voice-activated equipment for corpsmen showed a number of difficulties, even after field testing. These problems included oversensitivity of voice-activated microphones, a slowing of medics' efficiency when they were getting advice over telecommunications lines, and difficulty in keeping consultations short. The medics were also worried about whether such long consultations would expose them to detection.

Finally, an essential aspect of any system is a planned backup system in the event that the primary systems fail. The evacuation and supply systems that we propose have voice backups. Likewise, the treatment system we propose will have voice and data access, but <u>the essential backup system is trained personnel</u>.

The features that we describe here—such as reliability and security—are technical considerations. The next few slides present our findings concerning those technical considerations.

Step 4: Technical Considerations





So far, we have explained in general, nontechnical terms the characteristics of the systems needed to carry required information. In this section, we estimate demand and the technical requirements for providing that information. The details of our methodology and findings are presented in chapter 6, appendix B, and appendix G of our research memorandum [1].

Briefly, we used a clinical database being developed at the U.S. Directorate of Combat Doctrine Development to develop lists of tasks performed by personnel at the site of injury, the BAS, and the surgical company. We then used focus groups of operational Navy medical personnel to determine those tasks most likely to require teleconsulting at each location. Next we used the Time Task Treater file to identify which conditions required those tasks. Finally, we determined the probability of a casualty occurring by using Notional MEF Worst Case Scenario Patient Flow data from the Naval Health Research Center. These steps gave us the probabilities that consultations would occur.

Using these probabilities, we then used a modified needline analysis to estimate the medical communication requirements. This method has been approved by the JCS and used in earlier studies [2]. We also studied the information and communication architectures that will be available to an Amphibious Task Force in the 2000 to 2015 time frame.

In the next slide, we sketch the near-term and long-term feasibility of providing communication systems needed to carry required information.

Technical Systems

System	Content	Status	Cost
Evacuation	**data**	**here today**	$
Supply	**data**	**here today**	$
Treatment	**data**	**here today**	$
	voice	long-term (beyond 2005)	$$$$$
	image/ VTC	possible today (but problematic)	$$$

Based on our estimates of the information requirements for each of the three scenarios, we calculated the amount of time in a day the network will be used to exchange all necessary information (net loading) and the capacity needed to satisfy the estimated net loading (capacity requirements) for two systems:

- A low-capacity system that would support data/voice.
- A high-capacity system that would support image/VTC.

Using these calculations, capabilities of the current and expected DOD communication and information architecture, and those technologies currently available and being developed in the commercial sector, we determined the feasibility of fulfilling medical's information requirements in the short term (today through 2000), the near term (2000 to 2005), and the long term (beyond 2005). This table summarizes our findings.

Most of what we propose are low-capacity systems to support several distinct types of data transfer products, including e-mail, low-resolution graphics, text, electronic bulletin boards, and data streams. The technology for these types of **data** systems is here today, and the systems are comparatively inexpensive. Even better, they have some inherent security characteristics, such as the capability to be transmitted in "random bursts," making it more difficult for those trying to pinpoint where our transmitters are.

Technical Systems (continued)

System	Content	Status	Cost
Evacuation	data	here today	$
Supply	data	here today	$
Treatment	data	here today	$
	voice	**long-term (beyond 2005)**	**$$$$$**
	image/ VTC	possible today (but problematic)	$$$

The story for the treatment consultation system (voice, image/VTC) is more complicated. Providing unlimited **voice** consultation down to the unit corpsman is problematic. Because of the large number of potential users and connections, a voice consultation system is relatively expensive, both in terms of dollars and bandwidth, and will easily overwhelm any low-rate data system today and in the near future.

With today's equipment and technology (through 2005), the voice requirements that we estimated for medical would use over 50 percent of the available channels in an operational area (unlikely that the warfighters are going to go for that). Expected technological advances will significantly increase overall capacity. That means, as we move to 2005 and beyond, medical's need for channels and system capacity will represent an increasingly smaller portion of the pie.

We found that code division multiple access (CDMA), a broadband wireless technology currently being researched and developed in the commercial sector, may have the capacity to support the voice consultation system that we propose (this is expected in the 2005 to 2010 time frame). The CDMA technology also has some inherent antijam, low-probability-of-detection properties that make it particularly useful for both medical voice systems, and to the warfighter functioning under the future concepts of operations.

Technical Systems (continued)

System	Content	Status	Cost
Evacuation	data	here today	$
Supply	data	here today	$
Treatment	data	here today	$
	voice	**long-term (beyond 2005)**	**$$$$$**
	image/ VTC	possible today (but problematic)	$$$

(Voice, continued)

Despite the future's greater communication capacity, the voice consultation system we recommend has the potential to strain even a CDMA system, simply because it will support so many individuals (down to the unit corpsman and in some cases the individual Marine). To alleviate pressure on the system, we recommend exploiting other forms of data transfer (artificial intelligence, diagnostic screens/templates, E-mail, low-resolution graphics, and numeric strings) and increased training in medical skills and communication discipline. All of these will help to reduce the reliance on voice consultation.

Technical Systems (continued)

System	Content	Status	Cost
Evacuation	data	here today	$
Supply	data	here today	$
Treatment	data	here today	$
	voice	long-term (beyond 2005)	$$$$$
	image/ VTC	**possible today (but problematic)**	**$$$**

The other question mark is for the high-capacity system needed to support **image transfer and full-motion video** for treatment consultation at the surgical companies. It is technically possible to provide this communication capability today. All that is required is the communication equipment (e.g., a parabolic antenna about 7 to 9 feet in diameter, transceiver equipment), leased use of a satellite communication channel, and leased service of an earth station. Because military SATCOM capacity is and will continue to be insufficient for warfighting uses, medical would need to rely on commercial SATCOM.

At present, however, significant costs are associated with SATCOM capability both in terms of dollars and, perhaps more importantly, in terms of operational mobility of the surgical companies. The equipment required to support these communications today is heavy and bulky, requiring transportation and logistics support. In addition, surgical companies could not share equipment. If a surgical company was required to split (as they are currently configured to do for enhanced mobility), both halves of the company would require SATCOM links, equipment suites, and transportation and logistic support to maintain communication connectivity. Alternatively, both halves of the company would have to remain within line of sight of each other. Either way, their mobility and ultimately their ability to support the troops would be severely limited.

Technical Systems (continued)

System	Content	Status	Cost
Evacuation	data	here today	$
Supply	data	here today	$
Treatment	data	here today	$
	voice	long-term (beyond 2005)	$$$$$
	image/ VTC	**possible today (but problematic)**	**$$$**

(Image/VTC continued)

Technological advances are rapidly decreasing the cost of SATCOM, and equipment is being developed by the commercial sector that is significantly lighter and more mobile. For example, the parabolic antenna may soon be replaced by a flat, phased-array antenna about the size of a sheet of notebook paper that can be mounted flat on the roof of a vehicle.

Summary and Discussion

- Training is essential for integration of new communication systems
  - Ability to use information
  - Avoid system overload
- Information preprocessors and interfaces needed to avoid information overload
- Investments in equipment and training required

In this annotated briefing, we've sketched a minimal system of information requirements and described what DOD must do to support the kind of system we envision (and, incidentally, what Sea Dragon will need for warfighters). To support this system, DOD needs to exploit a technology such as CDMA technology, which has much greater capacity and natural security properties that are desirable.

But we don't want to lose track of three other important feasibility concerns: Training—both medical and communication training—is essential to make good use of medical communication and information systems. Second, formatting and screening of information is needed to avoid information overload. Third, we should invest in and exploit data systems, such as E-mail, electronic bulletin boards, streams of numbers, and artificial intelligence capabilities, to help reduce reliance on voice communications.

All three of these fundamentals should be observed for medical to grasp the great potential that the future of communications can hold. If medical does, we believe that it can use these opportunities to greatly improve situational awareness and medical treatment of casualties under the new demands of the future.

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[1] Neil B. Carey, Cori R. Rattelman, and Hung Q. Nguyen. *Information Requirements in Future Medical Operations,* Oct 1996 (CNA Research Memorandum 96-70)

[2] *PACOM Health Care Bandwidth Requirements,* briefing by GTE Government Systems, Chantilly, VA, 11 Jun 1996

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